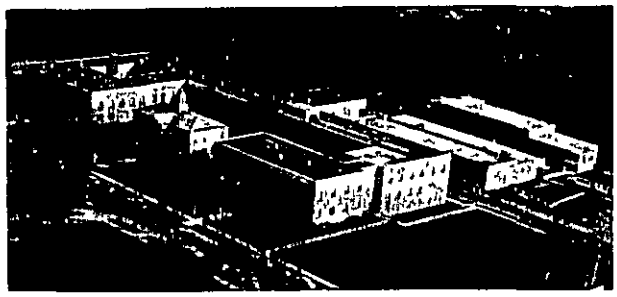

THE INSTITUTE OF PAPER CHEMISTRY, APPLETON, WISCONSIN

Project 2236

Report Five

A Quarterly Report

to

THE PIONEERING RESEARCH COMMITTEE
PIONEERING RESEARCH PROGRAM

March 23, 1962

THE INSTITUTE OF PAPER CHEMISTRY

Appleton, Wisconsin

THE MOLECULAR PROPERTIES OF NATURALLY OCCURRING POLYSACCHARIDES

THE EFFECT OF ION BINDING ON THE MOLECULAR PROPERTIES OF LOW MOLECULAR WEIGHT POLYSACCHARIDES

Project 2236

Report Five

A Quarterly Report

to

THE PIONEERING RESEARCH COMMITTEE
PIONEERING RESEARCH PROGRAM

March 23, 1962

TABLE OF CONTENTS

THE INSTITUTE OF PAPER CHEMISTRY

Appleton, Wisconsin

THE MOLECULAR PROPERTIES OF NATURALLY OCCURRING POLYSACCHARIDES

THE EFFECT OF ION BINDING ON THE MOLECULAR PROPERTIES OF LOW MOLECULAR WEIGHT POLYSACCHARIDES

SUMMARY

This is the fifth quarterly report on Project 2236, established in co-operation with the Pioneering Research Committee for the purpose of investigating the molecular properties of naturally occurring polysaccharides.

Diffusion and sedimentation data have been collected for sucrose and cellobiose in water, both with and without a high concentration of sodium chloride. A detailed analysis of these data is currently in progress. A preliminary analysis of diffusion data based on the Schlieren optical system indicates that the presence of sodium chloride has only a small effect on the diffusion of sucrose and cellobiose.

DISCUSSION

Within the last report period Dr. D. D. Bump has been added to the project. Much of his time has been spent in orientation. Dr. S. F. Kurath has been acting in an advisory capacity.

Sedimentation-equilibrium experiments were performed on aqueous solutions of sucrose and cellotriose. These experiments were carried out in the ultracentrifuge at 125,000 times gravity. At this gravitational field considerable distortion of the quartz windows in the centrifuge cell is observed. This distortion was great enough to invalidate these particular experiments. The quartz windows have recently been replaced with sapphire windows which have little or no distortion up to our maximum gravitational field of 256,000 times gravity. Four experiments have been conducted with these windows. Analysis of these experiments is currently in progress.

During the first two months of this report period, the ultracentrifuge has suffered five major breakdowns. Three of these were due to failures of new high-speed drives supplied under warranty by Spinco. Although the instrument was serviced on the day following the breakdown in four of the five cases, they each resulted in a loss of time of at least one week. This is due in part to the necessity of realigning the optics after each drive change. The drive now on the instrument has performed well over a long enough "break in" period that it is felt that it will hold up satisfactorily. However, the time during which the instrument is in operation has to be shared with other projects.

Due to the extremely high incidence of machine failure in the ultracentrifuge, we have decided to supplement our experiments with diffusion studies. There are several reasons for doing this. First, diffusion information properly collected will give information with regard to ion binding. Second, the Spinco

Model H electrophoresis-diffusion apparatus which will be used here will be less susceptible to breakdowns. When something does go wrong, it is generally possible to recover the experiment. Third, it will allow work to proceed while the ultracentrifuge is being repaired. It should be noted that the ultracentrifuge approach is not being abandoned, but is being supplemented and expanded by diffusion studies.

Several diffusion experiments have already been conducted. The experiments were carried out in a Tiselius cell under conditions of free diffusion at 30°C. The Spinco Model H instrument has three optical systems: Schlieren, Gouy, and Rayleigh. The Schlieren optical system gives a photographic record of the refractive index gradient across the diffusing boundary while the Gouy and Rayleigh systems yield interference patterns. The optics of the instrument are such that Rayleigh and Schlieren systems may be used simultaneously. In the diffusion experiments thus far, we have used these two systems exclusively. The results of six experiments for sucrose and cellobiose in water and in the presence of sodium chloride are given in Table I.

TABLE I

Sugar	Sugar Concentration, M	NaCl Concentration, M	Diffusion Coefficient, $D \times 10^{+6}$, sq. cm./sec.
Sucrose	0.02794	0	5.6 ± 0.5
	0.02938	0.2628	5.4 ± 0.5
Sucrose	0.02889	0	5.8 ± 0.5
	0.02755	0.02958	5.6 ± 0.5
Cellobiose	0.02823	0	5.0 ± 0.5
	0.02958	0.2958	6.0 ± 0.5

The diffusion coefficients were estimated from the Schlieren patterns and are not believed to be accurate to better than 10%.